**FIRM PROFILE**

**Established 2002**

**Ownership Type**
LIMITED LIABILITY CORPORATION

**Client Markets**
CAMPUS UTILITIES
COMMERCIAL
GOVERNMENT
HEALTHCARE & SENIOR LIVING
HIGHER EDUCATION
K-12 EDUCATION
SCIENCE & TECHNOLOGY

**Core Engineering Services**
MECHANICAL & ELECTRICAL
PLUMBING & FIRE PROTECTION
MASTER PLANNING
ENERGY MODELING
GEOTHERMAL DESIGN
COMMISSIONING & RETRO-Cx
3D LASER SCANNING & MODELING

**MEP Associates, LLC** is a full service, multi-disciplinary engineering and consulting firm focused on the design and future of sustainable, energy efficient solutions for projects nationwide. Our expertise includes mechanical, electrical, plumbing, fire protection, 3D laser scanning as well as commissioning, and energy modeling services.

We specialize in the design of geothermal, photovoltaic, solar, thermal storage and other renewable technologies. We attribute our continued success through the utilization of proven energy technologies that enhance building efficiency and minimize energy consumption.

Over the past decade, we have grown to a team of approximately 90+ employees in seven office locations. Our staff includes professional engineers, project managers, commissioning agents, system designers, CAD/Revit technicians, field technicians, construction administrative personnel as well as administrative, and technical support.

**MEP Office Locations**
Eau Claire, WI • Madison, WI
Eagan, MN • Rochester, MN
Columbus, OH • Norman, OK
Iron Mountain, MI

**Registered Professional Engineers in the Following States:**
AL, AR, AZ, CA, CO, CT, DC, FL, GA, IA, ID, IL, IN, KS, KY, LA, MA, MD, MI, MN, MO, MS, MT, NC, ND, NE, NH, NJ, NM, NV, NY, OH, OK, OR, PA, SD, TN, TX, UT, VA, VT, WV, WI, and WY.

*Our mission:* We continuously strive for excellence and innovation through creative engineering solutions to minimize environmental impact today and improve sustainable stewardship into the future.
## OUR CORE ENGINEERING SERVICES

### MECHANICAL
- Facility Assessment & Energy Analysis
- Life-Cycle Cost Analysis
- Feasibility Studies
- HVAC Systems
- Central Chiller Plants
- Central Heating Plants
- Ice Storage
- Industrial Ventilations
- Energy Recovery
- Temperature Controls
- Solar Thermal Systems
- Infrastructure Master Planning
- Dedicated Outdoor Air Systems (DOAS)
- Radiant Heating
- Industrial / Laboratory Space Conditioning & Ventilation

### ELECTRICAL
- Facility Assessment & Energy Analysis
- Infrastructure Master Planning
- Life-Cycle Cost Analysis
- Primary Power Distribution
- Secondary Power Distribution
- Emergency Power
- Fault Current Analysis
- Cogeneration
- Uninterruptible Power Supply
- Power Conditioning
- Fire Alarm Systems
- Interior and Exterior Lighting System Design
- Solar Photovoltaic (PV) System Design
- Arc-flash Hazard Analysis
- LEED® Compliant Lighting Design
- State and EPA Energy Code Compliance

### GEOTHERMAL
- Facility Assessment & Energy Analysis
- Infrastructure Master Planning
- Life-Cycle Cost Analysis
- Vertical Bore field Design
- Horizontal Bore field Design
- Pond Loop Design
- Geothermal Site Planning
- Geothermal Bore field Operational Analysis

### MEDICAL GAS
- Manifolds, Piping, Valve Boxes, Gauges & Outlets
- Medical Air Compressors
- Medical / Dental Vacuum Pumps & Systems
- Medical Gas / Liquid Oxygen
- Storage & Bulk Storage Facilities

### LEED CONSULTING
- Eco-Charrette Facilitation
- LEED® Process Consulting
- LEED® Submittal Preparation
- Daylighting Analysis
- Photometric Site Lighting Design & Analysis
- ASHRAE 62.1 Ventilation Calculations
- ASHRAE 90.1 - Appendix G Compliant Energy Modeling
- LEED Fundamental & Enhanced Commissioning Services
- Water Use Reduction Calculations
- Renewable Energy Systems Design

### COMMISSIONING
- LEED® Pre-requisite / Enhanced Services
- New Building Reviews
- Training & Operational Programs
- Owner’s Technical Representation
- Construction Administration
- Retro-Commissioning
- Maintenance Program Development

### 3D LASER SCANNING & MODELING
In today’s economic climate of high and rising fuel costs, many owners benefit from examining new and creative ways to trim their energy bills.

One beneficial option, especially for large facilities with simultaneous heating and cooling loads, is to examine the potential of a source that is already available, re-purposing heat that is ordinarily discarded by the HVAC system’s condenser.

By utilizing heat pump chillers with geothermal storage instead of conventional chillers, the temperature of this formerly waste heat can be increased until it is suitable for a wide variety of heating applications and utilized when it is needed.

Geothermal heat pumps have been used to provide heating and cooling in individual buildings for many years. Over time, the engineering industry has transformed how the technology is being applied. The transition to large campus / district energy networks, for universities, healthcare and government facilities, commercial or other building communities provides the next step in the implementation and development of geothermal systems.

Today, it is one of the best ways to keep facilities warm in the winter and cool in the summer, while saving energy and reducing the use of fossil fuels and ultimately the facilities carbon footprint.

PROJECTS
BALL STATE UNIVERSITY
Muncie, Indiana
Campus Geothermal Feasibility Study
Campus Geothermal Conversion Design
District Energy Station North (LEED® Gold)
District Energy Station South (LEED® Gold)
CARLETON COLLEGE
Northfield, Minnesota
Campus Utility Master Plan & Implementation
CORNELL NY TECH - BLOOMBERG CENTER
Roosevelt Island, New York
Campus Geothermal Feasibility Study & Design
CONFIDENTIAL CLIENT
Verona, Wisconsin
Geothermal Borefield Analysis & Design
Campus 2 & 3; Geothermal HVAC Design
Farm Campus; Geothermal HVAC Design
New Central Energy Plant
FORD MOTOR COMPANY
Dearborn, Michigan
New Campus Energy Plant
Low Entropy Campus Study
Geothermal Borefield Design (Phase 1)
FIVEPOINT - SF SHIPYARD
San Francisco, California
Eco-District Campus Design
GRINNELL COLLEGE
Grinnell, Iowa
Campus Infrastructure Master Plan & Implementation
MIAMI UNIVERSITY
Oxford, Ohio
Central Energy Plant Design
Western Campus Geothermal Design & Conversion
East Quad Geothermal Feasibility Study & Conversion
South Quad Steam-to-Hot Water Conversion
MISSOURI UNIVERSITY OF SCIENCE & TECH
Rolla, Missouri
Campus Geothermal Conversion
STUDIES
BOWLING GREEN STATE UNIVERSITY
Bowling Green, Ohio
Campus Geothermal Feasibility Study
DOMINICAN UNIVERSITY
River Forest, Illinois
Campus Geothermal Feasibility Study & Energy Analysis
ELON UNIVERSITY
Elon, North Carolina
Campus Geothermal Feasibility Study

FORDHAM UNIVERSITY
Bronx, New York
Campus Geothermal Feasibility Study & Energy Analysis

LINDT CHOCOLATE
Stratham, New Hampshire
Geothermal Feasibility Study

MILWAUKEE AREA TECHNICAL COLLEGE
Mequon, Wisconsin
Campus Geothermal Feasibility Study

NORTHWESTERN UNIVERSITY
Evanston, Illinois
Alternative Energy and CHP Study

OHIO STATE UNIVERSITY
Columbus, Ohio
Infrastructure Master Plan Study

PENN STATE UNIVERSITY
State College, Pennsylvania
East Residence Halls; Geothermal & Waste Effluent Heat Exchange Feasibility Study

PREVENTION GENETICS
Marshfield, Wisconsin
Geothermal Feasibility Study

PRINCETON UNIVERSITY
Princeton, New Jersey
Campus Infrastructure Master Plan Study

STANFORD UNIVERSITY
Stanford, California
Lake Water Irrigation Study

UNIVERSITY OF COLORADO
Boulder, Colorado
Campus Master Planning Study

U.S. DOE, ARGONNE NATIONAL LABORATORY
Argonne, Illinois
Campus Geothermal Feasibility Study

WATCHTOWER, WORLD HEADQUARTERS OF JEHOVAH'S WITNESSES
Warwick, New York
Campus Geothermal Feasibility Study & Design

YAHOO, INC. – DATA CENTER
Omaha, Nebraska
Closed Loop Lake Heat Exchange Study
BALL STATE UNIVERSITY
CAMPUS GEOTHERMAL CONVERSION
MUNCIE, INDIANA

TYPE GEOTHERMAL CONVERSION
GEOTHERMAL SYSTEM 10,000-TONS COOLING, 152,000,000 BTU/HR HEATING
SIZE 5,600,000 SF / 47 BUILDINGS
STATUS ONGOING
COST $83 MILLION

DESN - LEED® CERTIFIED GOLD
DESS - LEED® CERTIFIED GOLD

ENERGY USE INTENSITY
The geothermal conversion has reduced the BSU campus energy usage intensity.
Prior to Conversion 175 KBTu/sf/yr
As of 2013/2014 123 KBTu/sf/yr
Anticipated at Completion 105 KBTu/sf/yr

Since 2009, MEP has been providing professional engineering services as the lead designer for the Ball State campus geothermal conversion project. The system has eliminated the four coal burning plants, cutting its carbon footprint nearly in half, heating and cooling 47 buildings, resulting in over $2 million in annual savings. The new geothermal system features three (2) vertical loop fields at 400 - 500 feet each, 10 miles of buried distribution piping, 1,000 miles of loop field pipe, two district energy stations and four 2,500-Ton heat pump chillers.

CAMPUS ENERGY STATIONS
DESN: The 12,000 SF District Energy Station North was designed to house two 2,500-Ton compound centrifugal compressor, heat pump chillers, and accessory components. The DESN features a modular, maintenance-free plant system, a green roof and has achieved LEED Gold Certification.

DESS: The 16,480 SF District Energy Station South was designed to house two 2,500-Ton compound centrifugal compressor heat pump chillers, two centrifugal chillers, and a 4,000-Ton cooling tower. The DESS is anticipated to achieve LEED Silver certification.

DESN Fluid Cooler: This included the addition of a 1,000-Ton Fluid Cooler.

BOREFIELDS
North: Consists of 1,800 - 400 feet deep bores
South: Consists of 1,583 - 500 feet deep bores

UTILITY DISTRIBUTION
North Packages 1 & 2: Included construction of new chilled and hot water supply and return distribution piping north of Riverside Avenue for the North Bore field and District Energy Station North.

South Packages 1-3: Included construction of new chilled and hot water supply and return distribution piping for south of Riverside Avenue for the South Bore field and District Energy Station South.

ENVIRONMENTAL IMPACT
The completion of Ball State’s geothermal project will improve local health conditions, help reduce acid rain, and cut down man-made contributions to climate change. Not burning 36,000-Tons of coal annually eliminates the university’s direct generation of:
- 75,000-Tons of carbon dioxide emissions
- 240-Tons of nitrogen oxide
- 200-Tons of particulate matter
- 80-Tons of carbon monoxide
- 1,400-Tons of sulfur dioxide
- 3,400-Tons of coal ash - (which otherwise would be dumped in a landfill)
BSU CAMPUS BUILDING CONVERSIONS
The BSU campus buildings were converted to a hot water distribution system by interfacing with the existing steam heat exchangers. Most buildings included new pumps and variable frequency drives. Some buildings replaced steam heat coils with new hot water coils, interfaced with existing chilled water coils, and included new domestic hot water heat exchangers. Steam remains as a backup for building heating systems. All buildings are connected to the building automation system and communicate with the District Energy Stations.

Below is a list of the building conversions have been completed over the course of four years.

Package A
- HPAB
- Irving Gymnasium
- Student Recreation & Wellness Center
- Lewellen Pool
- Field Sports

Package B
- Robert Bell Building
- Letterman Communications Building
- Edmund F. Ball Building
- Arts & Journalism Building

Package C
- Architecture Building
- Health Center Building
- Kinghorn Hall
- Noyer Hall

Package D
- Park Hall
- Dehority Complex

Package E:
- Administration Building

Package F:
- Music Instruction Building (MIB)

Package G:
- Fine Arts Building

Package H
- Music Hall
- Emens Auditorium
- Arts & Communications
- Pruis Hall

Package I
- Burkhart
- West Quad
- Ball Gym

Package J
- Burris School
- Lucina Hall

Package K
- Student Center
MEP was hired as a consultant to provide analysis and design for the utilization of geothermal energy to manage the heating and cooling needs for the campus. The geothermal system located on the Western campus features a vertical bore field (315 bores) and matt pond loop field (133 loops) for optimal utilization of green space on the campus.

**PROJECT SCOPE INCLUDED:**

- Review the implementation options available to address the needs of additional buildings on campus
- Program verification for the proposed mechanical geothermal HVAC systems including the new Western Central Energy Plant (CEP)
- Mechanical and electrical engineering design services for the first portion of the proposed new geothermal bore field
- Bore field design included all vertical heat exchangers, lateral and loop piping up to centralized vaults, including manifold header system with vaults
- Mechanical and electrical design for the new Energy Station Plant, including chillers, pumps, piping, HVAC, plumbing, fire protection, power distribution, and lighting
- Engineering design for bore field expansion to a total of 700 bores
- Engineering schematic design & space planning for Phase 2 of the (CEP) was completed in 2017
- Energy modeling for new residence and dining hall buildings on the Western campus
- Life-cycle cost analysis for geothermal chiller options
- Cooling load analysis for the Maplestreet Station HVAC
MEP conducted an campus utility plan and study to evaluate the feasibility of a North Campus geothermal system and to analyze the short and long term considerations affecting the operation of campus facilities.

The study included the analysis pertaining to the design and optimization of the North Chiller Plant with modifications to the existing HVAC systems in select buildings, and implementation of central plant heat pump technology.

Two scenarios were analyzed to determine the benefit associated with heat pump integration and academic building hot water service. The first scenario assumed that all academic buildings would utilize hot water for space conditioning from the heat pump.

Annual operational cost savings was established by determining the total heating hot water and chilled water that could be generated by the heat pumps and utilized.

The second scenario focused on the incremental benefit associated with hot water service at individual academic buildings. This analysis assumed that each building would be able to maximize benefit from the operation of the heat pump.

**PROJECT SCOPE INCLUDED:**

- North Chiller Plant (NCP) Geothermal Conversion Study
- Energy Modeling for East Quad & State (Academic) buildings
- Master Plan for future Geothermal System (Serving East Quad, North Quad & State (Academic Buildings)
- Extension of existing chilled water system into renovated East Quad buildings
- Conversion of stand-alone process (24/7) chilled water systems in State (Academic) buildings to chilled water provided by the NCP
- Electrical site infrastructure modifications
- Conversion of steam building heating to a new heating hot water system fed from the NCP to serve East Quad & State (Academic) buildings
**NORTH CHILLER PLANT**

The North Chiller Plant (NCP) renovations include two new 350-ton heat pump chillers, and new heating hot water system with heat generated by heat pumps and steam to hot water heat exchangers.

The NCP is setup to utilize geothermal energy to generate additional heating and cooling capacity and further eliminate steam use. NCP total system capacities of 5,900-tons of cooling and 23,900 MBH (108,000 MBH future total) of heating.

**UTILITY DISTRIBUTION**

Chilled water and heating hot water piping systems consist of a primary, distributed secondary pumping system. The primary pumps circulate water through the chillers, heat pumps, HX’s in the NCP, and each end-user building houses the secondary distribution pumps which pull and push water from/to the NCP and circulate water through their respective building.
Ford Motor Co. is underway on a 10-year overhaul of its Research and Engineering Center (REC), aimed at modernizing a collection of 60-year old buildings that have stood at the heart of the U.S. auto industry. The transformation includes a new Central Energy Plant (CEP), Campus Distribution Systems, and phased replacement of existing Research and Engineering buildings. Approximately 4 Million GSF of existing structures will be demolished and replaced by an estimated 6 Million GSF of modern office, research, and design space. A key driver of this transformation is to consolidate the existing fragmented Ford footprint throughout Dearborn and replace it with a centralized campus.

MEP Associates was initially engaged by FordLand to extend previous master planning efforts to a complete energy master plan to optimize the development of a Low-Entropy Campus with a highly efficient CEP. The CEP will replace an aging central steam system and distributed cooling assets with a 3000-ton geothermal system, a 19,000-ton chilled water system, low-temperature water-based energy distribution loops (42°F chilled water and 120°F hot water), 40,000 ton-hours of thermal energy storage, and on-site electrical generation via combined heat and power. The combined heat and power assets include two SolarTurbine Titan 130s with heat recovery steam generators (HRSGs) and a steam turbine generator. These assets create 34MW of peak electrical capacity while providing nearly 200klbs of steam to process loads throughout the center. Waste heat from the steam turbine and excess steam from the HRSGs is used to supply capacity to the hot water system via centralized heat exchangers. The unique plant fully integrates various energy production assets to maximize reliability, energy efficiency, and long-term operational optionality for Ford.

In collaboration with FordLand, MEP Associates led the selection process of a design-build-own-operate-maintain (DBOOM) contractor to deliver and operate the facility over a 30-year term. DTE Energy Services was selected as the CEP partner and MEP seamlessly integrated with their project delivery team to finalize the CEP design and support the project through construction.

Phase 1 will come online in spring 2019. The Central Energy Plant design will include a combination of central heat pumps, chillers, cooling towers, heat exchangers, boilers, and cogeneration.
MEP was hired as a consultant to provide geothermal expertise at the new Cornell NYC Tech - Bloomberg Center campus on Roosevelt Island.

The Bloomberg Center is designed to utilize a vertical borehole heat exchanger that will meet the building heating and the cooling demands. The 150,000 SF building has a modeled peak load on the ground heat exchanger of 265-Tons of cooling.

The designated "Campus Lawn" area includes a green space which can accommodate approximately 80,350 feet deep bores. Pumping water from the annular spaces of the ground water-filled bores was found to have a desirable effect on the heating/cooling performance of the borehole heat exchangers, as the water was being constantly replenished by fractures at the bottom of the field.

Based on field test results, it was estimated that this pumping might itself be able to provide about 20,000 BTU/HR of cooling per bore resulting in a total peak load reduction of over 100-Tons on the field. This eventually eliminates the operation of cooling towers during the time at which the building peaks at the expense of pumping water from the annulus.
In its 2011 Climate Action Plan, Carleton College laid out a plan to become carbon-free by 2050. A 2016 utility master plan assessed the existing systems and made recommendations for new technologies to help the college reach its long-term goal of carbon neutrality. These recommendations are being implemented in a multi-year, multi-phased campus conversion project.

The existing gas-fired boilers and high-pressure steam distribution piping will be replaced with a 120°F heating hot water system served by a new geothermal system comprised of a water to water heat pump and a series of geothermal borefields located throughout campus. The new geothermal system is capable of providing simultaneous heating and cooling and will be sized to meet the campus’ continuous heating and cooling demand. New high efficiency gas fired boilers will be installed to address the peak heating demand, and the existing chiller will remain in service to address the peak cooling demands.
As part of this comprehensive utility project, Carleton College is incorporating an energy station into its new science building, which is currently under construction. The new East Energy Plant will house the new geothermal system, campus pumps and ancillary equipment and will be the primary source of chilled and heating water generation for the campus once the conversion project is complete. Until the campus conversion is complete, the new system will be supported by the existing energy plant, located on the west side of campus, which will also be retrofitted during the steam-to-heating water campus conversion.

With the completion of this project, Carleton College will be the first campus in the United States to transition its entire utility system off of steam heating.
The Princeton Infrastructure Master Plan provides the framework to support the University's goal to integrate sustainability in the long-term growth of the campus utility infrastructure and systems.

MEP was hired to perform a geothermal feasibility study and develop a comprehensive plan to address the reduction of GHG emissions utilizing a geothermal system to support the campus utility needs.

MEP investigated various options for geothermal system configurations. The evaluation of these systems was based on energy, economic and environmental impact of pursuing a geothermal system. Results of the study were incorporated with other utility approaches in Princeton's campus planning framework.

**CAMPUS EMISSIONS GOALS**

- **REDUCE ON-SITE CAMPUS EMISSIONS TO 1990 LEVELS (95,000 METRIC TONS) BY 2020**
- **CURRENT GHG ARE ~115,000 METRIC TONS ANNUALLY**
MEP was commissioned to perform a campus mechanical infrastructure master plan study in concert with an the overall campus plan. The focus was to cast a new vision for the campus infrastructure to support heating and cooling needs in a sustainable, efficient and in a fiscally responsible manner for this generation and those to come.

The master plan examined 21 buildings on campus, including West Science Center, and the sequenced capital projects over the next 20 years. As a part of the study, MEP performed the following tasks:

- Investigated the existing mechanical infrastructure systems and distribution serving these buildings
- Identified the existing assets available on campus
- Reviewed the electrical and natural gas bills
- Created a campus energy profile for the existing campus and calibrated it against historical data
- Developed strategies for revitalizing the failing campus infrastructure
- Created campus energy profiles for each of the four phases as the campus transitions through the Campus Master Plan
- Estimated potential annual energy footprint reduction, utility cost savings, and carbon footprint reduction between the recommended systems vs. the business as usual base case
- Provided recommendations based on the findings
Since 2012, MEP has provided professional engineering design services to the mechanical contractor and owner on one of the largest geothermal heating and cooling systems in the Nation. Our team works on-site directly with the engineering and contractors team to provide analysis, support, and design for the existing campus mechanical systems and future expansion.

ENGINEERING DESIGN SERVICES INCLUDED:

- HVAC analysis and investigation for each of the existing campus buildings six (6) 120,000 SF buildings, four (4) 170,000 SF buildings, and one (1) 750,000 SF auditorium/training facility.
- Analysis of the existing GSHP capacity.
- Geothermal heat exchange design for a new 750,000 SF building with an approximately 2,000-Ton system.
- Design of 35,700 linear feet of 36” supply-return piping infrastructure throughout the campus.
- Design of ten (10) Valve Vaults to isolate each building loop.
- Hydraulic model of the entire piping system illustrating the flows and pressures throughout the piping system allowing analyses of pump and pipe sizing to ensure the system operates at peak efficiency.
- Design of new Matt Pond (1,296 loops) and Bore field 4 (2,596 bores).
- Six pumps designed to pump 60,000 gpm of loop water around the campus to serve stand-alone heat pump chiller plants.
- Six pumps designed to pump 60,000 gpm through 6,172 vertical bores and 1,296 pond loops.
CAMPUS MAP

1) BORE FIELD 3
Design/engineering of 2,000 bores with average depths of 440 feet.

2) FARM CAMPUS (CAMPUS 3)
HVAC design/engineering for three office buildings, a large underground parking structure, commercial kitchen and provisions for two additional office buildings. A central energy plant was designed to provide chilled and heating water for the Farm Campus while utilizing the distribution loop.

3) UTILITY BUILDING 3 & 4
HVAC design/engineering for a new central energy plant and air-handling distribution systems, which is integrated into the campus geothermal distribution loop. A plate-and-frame heat exchanger is used for free cooling using the geothermal water when conditions permit.

4) UTILITY BUILDING 1 (CENTRAL PUMP STATION)
Design/engineering of the addition to the central pump station. Four (4) 450-hp pumps were added and tied into the existing 40,000 GPM system bringing the total flow up to 60,000 GPM. The four geo fields interconnect at the central pump station creating two large distribution loops: geo bore-field and geo campus distribution.

5) GEO POND 4
Design/engineering for the 1,296 loops currently resting on the bottom of a 10-15 feet deep, 5.8 acre pond. The pond is utilized mostly to cool the geo fields during winter.

6) CEP (CENTRAL ENERGY PLANT)
MEP designed/engineered the CEP to support the cooling and heating needs of Campus 4, Campus 5 and up to (13) additional buildings. The design was phased to such that the systems have flexibility and functionality to bring multiple buildings on-line over an extended construction period. Hydraulic models were developed and evaluated to determine the most efficient, economical and feasible pump sizes and arrangements.

7) BORE FIELD 4
Design/engineering of 2,596 bores with average depths of 500 feet. In addition to the bores, a large valve vault was designed such that the bore field could follow a phased construction schedule and be fully utilized during the installation of the remaining bores.
8) CAMPUS 4
HVAC design/engineering for the five (5) buildings and 4-level, underground parking structure. Each building includes two (2) main air-handling units with a set of chilled, heating and snow melt pumps. The chilled and heating water systems are both served from the main CEP, which ultimately tie into the geothermal systems. The air-distribution systems are variable-air volume systems with reheat using low-temperature heating water and total energy recovery wheels for air-to-air heat exchange.

9) ANNEX
HVAC design/engineering for the 15,000 GSF contractor building. The building has a water-to-water heat pump, which is connected to the geothermal system, that provides heating, cooling or simultaneous heating and cooling. The air-distribution system is a variable-air volume system with reheat using low-temperature heating water.

10) CAMPUS 5
HVAC design/engineering for five (5) buildings and a 3-level underground parking structure, including multiple air-handling units, chilled water, heating water and snow melt pumps, energy recovery units, and exhaust fan-arrays. Chilled and heating water is provided via large site piping routed from the main CEP.

11) KINGS CROSS
HVAC design/engineering for the large food service building, which houses a commercial kitchen that serves up to 3,000 meals per day. The design included two (2) air-handling units zoned to provide makeup air for the eight (8) kitchen hoods.

12) K-BAKERY
HVAC design/engineering for a new bakery that was retrofitted into an existing campus building. The bakery included a 100 percent outdoor air unit to serve five (5) ovens, one (1) grease hood and one (1) dishwasher hood.

13) G1 OFFICE BUILD-OUT
Design/engineering for an office build-out in the newly completed auditorium.

14) BOILER TO HEAT PUMP CONVERSION
Design/engineering for a boiler replacement project, which converts a 180°F hot water boiler to a cascading water-to-water heat pump capable of supplying 130°F to 180°F heating water with a minimum COP of 2.7.

15) SITE PIPING
MEP continues to provide ongoing design/engineering for site utilities including: chilled, heating, snow melt and geothermal water piping. MEP develops hydraulic models using computer engineering software and evaluates the life-cycle, engineering and economics of various piping material and sizes.

16. OPEN LOOP PUMP STATION
An open loop pumping station is being designed and developed for the purpose of transferring energy to and from the large campus geothermal distribution loop utilizing a spring-fed lake.
MISSOURI UNIVERSITY OF SCIENCE & TECHNOLOGY
CAMPUS GEOTHERMAL CONVERSION
ROLLA, MISSOURI

TYPE GEOTHERMAL CAMPUS CONVERSION
GEOTHERMAL SYSTEM 2,000 -TONS COOLING, 40,272,000 BTU/HR HEATING
SIZE 2,170,000 SF / 15 BUILDINGS
STATUS COMPLETED 2014
COST $16.7 MILLION

AWARDS
2013 FIRST-PLACE SECOND NATURE CLIMATE LEADERSHIP AWARDS

ENERGY SAVINGS
The system is projected to save more than $1 million in energy savings and operational cost annually. This savings is expected to grow to $2.8 million annually in future years.

MEP was brought on board as a consultant to provide professional engineering design services for a portion of the campus at Missouri University of Science & Technology. The geothermal system was designed as a hybrid and is expected to replace the aging steam plant. The balance of the heating and cooling load is a combination of heat recovery chillers, heat exchangers, heat pumps gas fired boilers and existing distribution equipment.

The geothermal system will be utilized for the base heating and cooling with the reuse of the existing chilled water system for cooling peaks and new hot water boilers for heating peaks. Geothermal bore fields were separated into three power plants (Straumanis-James, Science Facility and the future James E. Bertelsmeyer Hall). There were 645 total bores for the three locations totaling an estimated 558,600 lineal ft. of 1 ¼" u-bend pipe and many miles of horizontal piping. Each power plant has multiple bore fields, with Straumanis-James topping out with six (6) separate locations.

The geothermal system will be tied into fifteen (15) separate campus buildings. These plants will contain screw type heat recovery chillers and serve adjacent buildings with heating water through a new heating hot water distribution system.

"This project and follow-on projects eliminated over $60 million in deferred maintenance, a more than 25 percent reduction in the $220 million deferred maintenance backlog the campus had before the project began." says James Packard, director of facilities operations at Missouri S&T. (September, 2015)
There is the need to develop a comprehensive and consistent approach to the integration of sustainable energy sources into the future of the campus. This study will be the first step to establish the feasibility of the responsible implementation of a campus wide sustainable energy strategy. The sustainable energy options will include or will be a combination of geo-exchange, energy recovery, and heat recovery. The Campus Energy and Sustainability Master Plan will address and coordinate within the framework of the current Campus Master Plan.

MEP Associates provided planning, mechanical, and electrical engineering services to complete the evaluation of the current and future energy needs. During the course of the project, MEP Associates has anticipated conducting the following tasks:

**ENERGY & SUSTAINABILITY MASTER PLANNING TASKS:**

- Conduct field investigation as required
- Review existing utility bills
- Review HVAC systems on a campus wide and building by building basis
- Interview facilities and maintenance personnel.
- Evaluate the feasibility of various sustainable energy (reduced scope to: geo-exchange system) strategies
- Establish current carbon footprint for the HVAC systems
- Implementation scheduling and phasing
- Prepare a preliminary Master Plan
- Develop a campus design standard for future projects
Bowling Green State University (BGSU) retained MEP Associates, LLC to perform a feasibility study to determine the energy, economic, and environmental impact of pursuing renewable systems on campus.

A long-range implementation plan was developed for a proposed geothermal ground source heat exchange system, which would provide renewable energy source for this campus. MEP project scope also included:

- Geothermal Ground Loop Design
- Heating & Cooling Load Analysis
- Energy Modeling
- Energy Analysis
- Economic Analysis (payback, life-cycle, ROI)
- Environmental Analysis (Carbon Footprint)
Ohio State University (OSU) campus is very large and is subdivided into districts. The university expressed interest in investigating geothermal feasibility for three of the existing districts located in the northern section of the campus. These include athletics, north residential, and St. John’s districts. In addition, investigation of a localized geothermal installation for the ULAR research building was requested.

MEP Associates was retained to perform a campus wide geothermal feasibility study. The intent of the analysis was to analyze the energy and economic consequence of pursuing a geothermal conversion for each campus district. Results of the analysis will be used to determine how geothermal conversion would benefit both OSU and the end user as campus buildings and layout change over the defined mast planning period of roughly 40-years.
The FivePoint San Francisco Shipyard development will serve as a model for modern sustainable city planning. This 702-acre area will house R&D facilities, commercial spaces, multi-use buildings and retail spaces. Parks, trails, and open spaces will be additional features that will attract and enhance the community.

The new development will add over 10,000 new residential units in the form of condominiums and low-, mid- and high-rise buildings. There will be over a million square feet of commercial space made available, over three million square feet for R&D, as well as over 300,000 SF of property devoted to community activities. Incorporated into this development will be a hotel, artist studios and art center, a marina, and a performance venue/arena.

MEP was hired to provide sustainable mechanical infrastructure, onsite power technologies, and emerging technologies.

CENTRAL ENERGY PLANT
The Central Energy Plant design includes four 350-Ton Chillit® screw chillers to provide simultaneous heating and cooling load and meet the 17,000 MBH peak heating load. Screw chillers are designed for a maximum of 130°F supply water temperature which can be used for the domestic water heating and space heating.

OPEN-LOOP WATER-SOURCED SYSTEM
To meet the Eco-Districts Phase 1 heating and cooling needs, the design includes a hybrid open-loop water-sourced system, which directly utilizes San Francisco bay water as thermal energy source and sink. The main components of the system will include two Titanium heat exchangers with a seawater filtration system.
MEP conducted a study for Grinnell College of existing campus infrastructure, energy usage profiles, and developed a comprehensive plan to address the increasing utility needs as they will be impacted with the implementation of various campus facility upgrades.

The plan is to optimize fiscal, environmental and energy resources on a campus wide basis. The evaluation included the necessary modifications to the campus chilled water and steam production and distribution systems to support the various building modifications. The objective is to make the most of the existing campus assets and prepare a vision for the future integration of new technology as opportunities arise.
Argonne National Laboratory commissioned MEP to perform a geothermal feasibility study for the potential integration to provide the HVAC energy needs on a campus, multi-building, scale.

MEP investigated six (6) various options for geothermal system configurations. The evaluation of these systems were based upon energy, economic and environmental impact of pursing a closed loop geothermal system. Results of the study will be used as a tool to assist Argonne in making an informed decision about the feasibility of further investigation of a large geothermal system installation.

The existing steam and chilled water systems serving the Argonne facilities have been in place for many years. Over the duration of operation, these systems have been adequately maintained and upgraded to accommodate expansion and modernization of the site and growth of research operations. Argonne National Laboratory is exploring alternative HVAC options to increase system efficiency and lower operational costs while promoting reliable renewable energy practices and environmental stewardship.
Sewage is a constant inexhaustible energy source and it is produced by all buildings throughout a campus. The aim of this study is to evaluate whether sewage heat transfer is a feasible means of heat recovery for the East Halls dormitory building cluster at Penn State University. This includes seven buildings (six residential dormitories and one dining center). The technical solution being examined foresees the use of a system in combination with a geothermal system as a heat sink and heat source for the HVAC system serving the buildings.

A “Sewage SHARC” system is capable of depositing or extracting thermal energy from existing sanitary lines before the wastewater is treated at a plant.

Heat pumps systems can connect directly to the SHARC heat exchanger and extract/deposit thermal energy as necessary depending on the conditioning needs of the building(s) served.
The new Under Armour Global Headquarters campus will feature a chilled water plant that utilizes bay water as a heat rejection source. The bay water will be pumped from an intake apparatus located in the bay, through titanium plate-and-frame heat exchangers and discharged to a high-performance lake. The high-performance lake will be used to filter bay water and before it is reintroduced to the watershed.

Construction of the new headquarters campus consists of twelve phases spanning a 20-year period. Right sizing the pumps is key and a challenge in itself. A cost-benefit analysis was conducted to balance the economics with the energy cost associated with operating different size pumps for the 12 phases.
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<td>Maple Grove, Minnesota</td>
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<td>Administrative &amp; Visitor Center; Geothermal System Design</td>
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</table>
SELECT GEOTHERMAL PROJECT EXPERIENCE

US FISH & WILDLIFE SERVICE
BIG STONE NATIONAL WILDLIFE REFUGE
Odessa, Minnesota
Energy Renovation & Geothermal System Conversion

US FISH & WILDLIFE SERVICE
MORRIS WETLANDS DISTRICT HEADQUARTERS
Morris, Minnesota
Energy Renovation & Geothermal System Conversion

US FISH & WILDLIFE SERVICE
MINNESOTA VALLEY NATIONAL WILDLIFE REFUGE
Bloomington, Minnesota
Energy Renovation & Geothermal System Conversion

US FISH & WILDLIFE SERVICE
TAMARAC NATIONAL WILDLIFE REFUGE
Rochert, Minnesota
Energy Renovation & Geothermal System Conversion

WABASHA COUNTY
Wabasha, Minnesota
Law Enforcement Center; Geothermal System Design

WI AIR NATIONAL GUARD
Milwaukee, Wisconsin
Security Forces CATM/CATS; New Building; Geothermal System Design (LEED Gold®)

WRIGHT COUNTY
Buffalo, Minnesota
Law Enforcement Center; Geothermal System Design

HEALTHCARE

BIGFORK VALLEY HOSPITAL
Bigfork, Minnesota
Critical Access Hospital; Geothermal System Design

HOUSE OF THE DOVE
Marshfield, Wisconsin
New Hospice Facility; Geothermal System Design

MAYO CLINIC
Menomonie, Wisconsin
New Dialysis Facility; Geothermal System Design

MARSFIELD CLINIC

NEILLSVILLE DENTAL CENTER
Neillsville, Wisconsin
New Dental Center; Geothermal System Design

RICE LAKE DENTAL CENTER
Rice Lake, Wisconsin
New Dental Center; Geothermal System Design

ORTONVILLE AREA HEALTH SERVICES
Ortonville, Minnesota
New Dental Center; Geothermal System Design

PREVENTION GENETICS
Marshfield, Wisconsin
New Laboratory Headquarters; Geothermal System Design

THE HEART DOCTORS HEART & VASCULAR INSTITUTE
Rapid City, South Dakota
New Healthcare Facility; Geothermal System Design

WESTERN WISCONSIN HEALTH
Baldwin, Wisconsin
New Critical Access Hospital & Clinic Geothermal System

IOWA BRAILLE AND SIGHT SAVING SCHOOL
Vinton, Iowa
Campus Geothermal Feasibility Study

MOORE ELEMENTARY SCHOOL
Moore, Oklahoma
New Elementary School; Geothermal System Design

OAKRIDGE ELEMENTARY SCHOOL
Moore, Oklahoma
New Elementary School; Geothermal System Design

PIERRE INDIAN LEARNING CENTER
Pierre, South Dakota
Dorm Renovation; Geothermal System Design

SANTA FE ELEMENTARY
Moore, Oklahoma
New Elementary School; Geothermal System Design

SOUTH PORTLAND ELEMENTARY SCHOOL
Oklahoma City, Oklahoma
New Elementary School; Geothermal System Design

K-12

BROCKTON HIGH SCHOOL
Brockton, Montana
Geothermal System Conversion

BRYANT ELEMENTARY
Moore, Oklahoma
School Addition; Geothermal System Design

CHEYENNE PUBLIC SCHOOL
Cheyenne, Oklahoma
Main Campus Building Conversion

DAWSON-BOYD PUBLIC SCHOOLS
Dawson, Minnesota
HVAC Replacement with Geothermal System

FREDERICK PUBLIC SCHOOL
Fredrick, Oklahoma
New Multi-Purpose Building; Geothermal System Design

HERITAGE TRAILS ELEMENTARY SCHOOL
Moore, Oklahoma
New Elementary School; Geothermal System Design